OPEN LETTERS.

NORMAL SOLUTIONS.

RECENTLY Mr. James B. Dandeno published an article[1] in which he accuses Kahlenberg and True[2] of having confused solutions containing gram-equivalents per liter with such as contain gram-molecules per liter. Because of the prominence given to Mr. Dandeno's article by publication in the BOTANICAL GAZETTE, I feel compelled to write this reply.

Kahlenberg and True have used both expressions, gram-equivalent per liter and gram-molecule per liter, but they have not confused them. In the case of mono-basic acids and salts of mono-basic acids with monad metals a solution containing a gram-equivalent per liter is identical with a solution containing a gram-molecule per liter, and hence in such cases the terms are perfectly interchangeable. This fact Mr. Dandeno evidently overlooked and so he saw great confusion where none existed.

It will be necessary to take up Mr. Dandeno's points somewhat in detail. The expression, "Chemically equivalent quantities (*i. e.* molecular quantities) of the different substances were not compared," which Kahlenberg and True used on p. 85 of their article, occurs in the course of the general introduction and does not warrant (especially when taken together with the further discussion in the article) the conclusion of Mr. Dandeno that "they regard a gram-molecule per liter exactly the same as a gram-equivalent per liter." On p. 91 Kahlenberg and True say, referring to the various tables that follow, "In the first column appear the concentrations used expressed in gram-molecules or gram-equivalents per liter of the solution." As both expressions actually appear, and are properly used, in the headings of the tables that follow, the above statement (which refers to all the tables in the article, except tables 18 and 19 concerning which special mention is made on p. 97) *in itself* clearly does not warrant Mr. Dandeno's conclusion that the authors regarded a gram-molecule per liter as exactly the same as a gram-equivalent per liter.

Mr. Dandeno states that the normal solution of sulfuric acid used by Kahlenberg and True was "purchased from the chemist" and that it was "a gram-equivalent solution and was thought to be a gram-molecule solution." No statement is made by Kahlenberg and True that any solution was "purchased from the chemist," and Mr. Dandeno's inference is wholly baseless.

[1] BOT. GAZ. **32**: 229, Oct. 1901. [2] BOT. GAZ. **22**: 124, Aug. 1896.

As a matter of fact, I happen to be the chemist who prepared the normal sulfuric acid solution as well as the other solutions used by Dr. True and myself, and the strengths of all the solutions were exactly as indicated in the columns of the tables. The results of Kahlenberg and True indicate that $\frac{1}{6400}$ gram-equivalents of H_2SO_4 per liter is as toxic as $\frac{1}{6400}$ gram-equivalent of HCl per liter, and not that $\frac{1}{6400}$ gram-equivalent of H_2SO_4 per liter is as toxic as $\frac{1}{3200}$ gram-equivalent of HCl per liter as Mr. Dandeno states; this shows how much care he used in scrutinizing the tables he attempts to criticise.

Kahlenberg and True have found that a solution containing $\frac{1}{6400}$ of a gram-equivalent of H_2SO_4 (*i. e.* $\frac{49}{6400}$ grams) per liter is as toxic as a solution containing $\frac{1}{6400}$ of a gram-equivalent of $KHSO_4$ (*i. e.* $\frac{136}{6400}$ grams) per liter. Since $KHSO_4$ contains but one hydrogen atom, which is the active agent under consideration, either the term gram-equivalent or gram-molecule might be used concerning this substance, for they mean the same thing here; as a matter of fact the term gram-equivalent is used in Kahlenberg and True's table. There is no confusion in Kahlenberg and True's article on this point, as Mr. Dandeno thinks. On the bottom of p. 91 of Kahlenberg and True's paper is the statement, "Tables 1 to 5 show that the seedlings just survive in a solution that contains $\frac{1}{6400}$ gram of hydrogen ions per liter," which might have shown Mr. Dandeno that no confusion exists, had he read it with sufficient care.

To be sure Ostwald in his tables of electrical conductivity expresses the concentrations of the solutions in gram-molecules per liter; but this does not prevent one from calculating from these tables the degree of dissociation of a salt in a solution, the strength of which is expressed in gram-equivalents per liter, as Mr. Dandeno seems to think. Kahlenberg and True were well aware of the true character of Ostwald's tables, and in referring to them, and in calculating the dissociation from them, they took into consideration the fact that the tables are based on gram-molecules per liter. Take the case of maleic and fumaric acids of which Mr. Dandeno makes a special point. These acids are both dibasic. In Ostwald's tables[3] we find that when 1 gram-molecule of maleic acid is contained in 2048 liters, the degree of dissociation is 98.2 per cent.; and when 1 gram-molecule of fumaric acid is contained in 2048 liters the degree of dissociation is 78.5 per cent. Now in the case of a dibasic acid, a solution containing 1 gram-molecule in 2048 liters is clearly identical with a solution containing 1 gram-equivalent in 1024 liters; and so when Kahlenberg and True state "as maleic acid at the dilution 1024 is dissociated 98.2 per cent. and fumaric acid 78.5 per cent. we should expect the latter to be less poisonous than the former if the toxic action be due to H ions alone," they are perfectly correct. Moreover the tables (58 and 59, p. 115 of

[3] Zeitschrift physik. Chem. **3**: 380.

Kahlenberg and True) concerning these acids are both clearly headed "gm. equiv. per liter," which excludes all possibility of misconception. Mr. Dandeno clearly is in error; and for the piquant remarks in which he indulges on p. 234 of his article in referring to the comments of Kahlenberg and True on the behavior of maleic and fumaric acids, he deserves sharp censure.

Mr. Dandeno further complains that Heald[4] states in referring to Kahlenberg and True, "in these experiments the solutions were prepared according to gram-equivalents," and then Dandeno adds that on pp. 119–123 of Kahlenberg and True we find written "gram-mol. per liter." Now it happens that all the acids listed on pp. 119–123 by Kahlenberg and True are mono-basic acids, and that in the case of these a gram-molecule per liter is identical with a gram-equivalent per liter, so that Heald was correct in his statement. Evidently Mr. Dandeno failed to note the basicity of the acids listed by Kahlenberg and True on the pages last mentioned.

The two instances that Dandeno mentions, in which Kahlenberg and True have stated that a gram-equivalent is contained in so many liters of water instead of so many liters of solution, are cases in which the solutions in question were so extremely dilute, that no difference could be detected were the solutions made up on the one basis or the other. The instances occur, moreover, in the course of a preliminary general discussion where no sharp comparison is involved.

I have not taken the time to look up the work of the various other investigators that Mr. Dandeno attempts to criticise. It is of course possible that mistakes have been made; but from what has been said above, the reader can readily form an opinion as to Mr. Dandeno's competency to make such criticisms.

In conclusion, I wish to emphasize once more that all the solutions used by Kahlenberg and True were of exactly the strengths indicated in their tables, that the conclusions based upon them are correct, and that the interpretations of Mr. Dandeno are entirely wrong.—LOUIS KAHLENBERG, *Laboratory of Physical Chemistry, University of Wisconsin.*

I am limited to a brief reply to the foregoing letter. Regarding it I have to say:

It is fully explained in my paper[5] that, in the case of monobasic acids and salts with monad metals, gram-molecule and gram-equivalent solutions are the same. It was only where basicity differed that exception was taken.

In view of Dr. Kahlenberg's assertion, I withdraw fully the statement that the solution of sulfuric acid referred to was purchased from the chemist. I had Dr. True's statement that it was, but I must have misunderstood him.

However, Dr. True states,[6] referring to this table (H_2SO_4) headed

[4] BOT. GAZ. **22**: 125. Aug. 1896. [5] BOT. GAZ. **32**: 230–232. Oct. 1901.

[6] Quoted *l. c.*, p. 233.

"gram-equival. per l.," that, in chemical equivalent quantities of H_2SO_4 and of HCl, there are twice as many H ions in the H_2SO_4 as there are in the HCl. Dr. True clearly regarded this as a gram-molecule per liter solution, so my reference to this point is not without good ground.

Since Heald referred to the whole paper of Kahlenberg and True, and since several dibasic salts are there[7] listed "gram-molecule per liter," my general reference is abundantly warranted.

An illustration will make clear one misconception. Dr. Kahlenberg states that gram-molecule and gram-equivalent solutions of $KHSO_4$ are the same. I hold they are not. In a gram-equivalent per liter solution of $KHSO_4$ there is *one-half* gram of H. Dr. Kahlenberg's position is that there is *one* gram of H. If I misinterpret this substance I am in good company. (See definition gram-equivalent and references to Talbot, Mohr, Sutton, Fresenius, p. 230.)

As to dissolving substances in so much *water* or in so much *solution*, I may say that I am surprised at Dr. Kahlenberg's defending, *in any case*, the former method.

My paper was not written as a criticism of Kahlenberg and True, as he seems to think, though their work was freely drawn upon for illustration.—JAMES B. DANDENO, *Normal and High School, St. Louis, Mo.*

BASILIMA, SCHIZONOTUS, SORBARIA.

IN THE July number of the BOTANICAL GAZETTE (**32**: 56) Mr. Alfred Rehder discusses these names, reaching the conclusion that Sorbaria is the proper designation for the genus in which *Spiraea sorbifolia* Linn. is now placed. His decision in the case of *Basilima* Raf. seems unquestionable, viz., that when it first appeared, in 1815, it was a *nomen nudum*, and when republished in 1836 it was a synonym of *Schizonotus* Lindl. But why *Schizonotus* Lindl. should be set aside is not so clear to me. It is said that where it was first published, in Wallich's *Catalogue* (no. 703; Pritzel says that this portion of the *Catalogue* appeared 1 D 1828), this name was a synonym. The *Catalogue* is cited fully and correctly: "no. 703, Spiraea Lindleyana Wall. Schizonotus Lindl. (gen. nov. Spir. sorbifoliam amplectans)," but I fail to see how there is any synonymy here; if so, of what is Schizonotus a synonym? We have here rather an annotation. Wallich's *Spiraea Lindleyana* is said to belong to the new genus *Schizonotus* Lindl., based upon *Spiraea sorbifolia*. *Spiraea Lindleyana*, like most of the other names of Wallich's *Catalogue*, when divorced from the specimens which were intended to accompany it, is merely a *nomen nudum;* while *Schizonotus*, distinctly based upon a well-known species, *Spiraea sorbifolia*, is certainly not a *nomen nudum*, and can scarcely be held a synonym of one!

[7] BOT. GAZ. **22**: 96. ($CuSO_4$, etc.)